EP0111768

Publication Title:

A mechanical device for controlling a valve of a heat engine.

Abstract:

127a Abstract of EP0111768

The device is operable to allow the rise and phase of the valve (4) to be varied during operation of the engine (1) and is provided with a rocker (10) cooperating at one end (9) with a stem (5) of the valve (4) and at the other end (12) with an oscillating cam (14) of predetermined shape driven by a cam follower (24) slidable in a seat (25) and cooperating with a rotating cam (26) of predetermined shape. The cam follower (24) receives translational movement from the rotating cam (26) and transmits a reciprocating movement to the oscillating cam (14) and the rocker (10), and is operable to vary its length between two end positions to vary the timing and rise of the valve (4).

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 111 768**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 83111599.3

(22) Date of filing: 20.11.83

(51) Int. Cl.³: F 01 L 31/22
F 01 L 13/00, F 01 L 1/24

(30) Priority: 23.12.82 IT 6850682

(43) Date of publication of application:
27.06.84 Bulletin 84/26

(84) Designated Contracting States:
BE DE FR GB NL SE

(71) Applicant: FIAT AUTO S.p.A.
Corso Giovanni Agnelli 200
I-10135 Torino(IT)

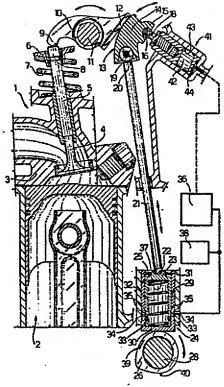
(72) Inventor: Titolo, Andrea
Via Canova 43
I-10100 Torino(IT)

(74) Representative: Bongiovanni, Guido et al,
c/o Ing. Carlo e Mario Torta Via Viotti 9
I-10121 Torino(IT)

(54) **A mechanical device for controlling a valve of a heat engine.**

(57) The device is operable to allow the rise and phase of the valve (4) to be varied during operation of the engine (1) and is provided with a rocker (10) cooperating at one end (9) with a stem (5) of the valve (4) and at the other end (12) with an oscillating cam (14) of predetermined shape driven by a cam follower (24) slidable in a seat (25) and cooperating with a rotating cam (26) of predetermined shape. The cam follower (24) receives translational movement from the rotating cam (26) and transmits a reciprocating movement to the oscillating cam (14) and the rocker (10), and is operable to vary its length between two end positions to vary the timing and rise of the valve (4).

EP 0 111 768 A1


10
12
14
15
16
43
41
9
6
11
13
19
20
42
44
7
8
1
5
4
3
18
21
36
38
37
22
25
23
31
29
35
34
33
24
32
27
39
28
26
40
2

A mechanical device for controlling a valve of a heat engine

The present invention relates to a mechanical device for controlling a valve of a heat engine, of the type operable to allow variation in the rise and phase of the valve.

Numerous mechanical devices for controlling the valves of heat engines, are known, which devices are able to allow the rise and phase of the valves to be varied. These generally include a rocker cooperating with the stem of the valve and driven by an oscillating cam. This latter is controlled by means of a crank and link mechanism the radius of the crank of which is variable. Generally an eccentric rod is used, pivoted to the oscillating cam and operated by the rotation of a shaft. By varying the radius of the crank the desired variation in the rise and phase of the valves is obtained.

The described devices have the disadvantage of giving a law of movement for opening of the valve different from that for closure thereof in that the foot of the link which controls the oscillating cam does not perform a rectilinear path but a circular one. Consequently the speeds and accelerations of the valves on opening and closing are different.

The object of the present invention is that of providing a mechanical control device for a valve of a

heat engine which will be free from the previously described disadvantages, and which will at the same time allow the rise and phase of the valve to be varied with a simple operation.

The said object is achieved by the present invention in that it relates to a mechanical device for the control of a valve of a heat engine, of the type operable to allow the variation in the rise and phase of the said valve, comprising an oscillating rocker pivoted at an intermediate point and operable to cooperate at a first end with the stem of the said valve which is movable along its axis against the action of resilient means, and at a second end, opposite the first, with a working surface of an oscillating cam of predetermined shape, and means for actuating the said oscillating cam, characterised by the fact that the said actuating means includes a cam follower connected in an articulated manner to the said oscillating cam and movable in a rectilinear manner within a seat, and a rotating cam of predetermined profile cooperating with the said cam follower for transmitting an oscillating movement through this latter to the said oscillating cam.

For a better understanding of the present invention there will now be given, purely by way of non-limitative example, a description of an embodiment thereof with reference to the attached drawings, which illustrate a sectional side view of a portion of a heat engine provided with a valve control device

formed according to the principles of the present invention.

In the attached drawing, the reference numeral 1 generally indicates a heat engine including cylinders 2 (of which only one is illustrated) and a cylinder head 3 provided with valves 4 (of which only one is visible) at each of the cylinders 2. Each valve 4 is provided with a stem 5 having a cap 6 and is movable along its own axis against the action of a spring 7 cooperating with the cap 6. This latter is fixed to the stem 5 at a head 8 thereof able to cooperate with a first end 9 of an oscillating rocker 10 pivoted at an intermediate point to a shaft 11 about which it is free to turn, and provided with a second end 12 opposite the end 10 cooperable with a working surface 13 of an oscillating cam 14 of predetermined shape. The cam 14 is eccentrically pivoted at 15 in a universal manner on a ball headed end 16 of a plunger 18 and is pivoted eccentrically at 19 to an end 20 of a push rod 21 connected in a universal manner at one end 22, opposite the end 20, to an element 23 of a cam follower 24 slidably housed in a seat 25 and cooperating with a rotary cam 26 of predetermined shape, belonging for example to a cam shaft 28 rotating in the direction of the arrow.

The cam follower 24 is movable in rectilinear manner within the seat 25 with respect to the axis of rotation of the cam 26 and its length can vary during operation of the engine 1 between two end-of-stroke positions one of which is illustrated in the drawing.

The cam follower 24 receives a reciprocating movement in consequence on the rotation of the cam 26, which it transmits to the shaft 21; consequently this makes the cam 14 oscillate about the fulcrum 16 eccentrically with respect to the shape of the working surface 13. The shape of this latter is such that it interacts with the end 12, with a predetermined relationship, consequently causing the rocker 10 to turn about the pin 11 in the direction of the arrows in an oscillating or reciprocating manner, thereby causing the end 9 to cooperate with the head 8 to move the stem 5 and therefore open and close the valve 4. The spring 7 maintains contact between the various elements of the valve actuating device avoiding separations from occurring during the course of the half of the oscillating movement during the return movement of the cam follower 24 towards the axis of rotation of the cam 26 (closure movement of the valve 4).

By varying the length of the cam follower 24 the end 22 can be moved closer to (or further away from) the axis of rotation of the cam 26, thereby causing a variation in the law of oscillatory movement transmitted to the cam 14 and consequently the rise and phase of the valve 4 can be varied at will within a range of predetermined values.

In the non limitative example illustrated the desired variation in the length of the cam follower 24 is obtained by utilising a cam follower including

the said element 23 and an outer cup-shape element 29 slidably housed in the seat 25, cooperating with the cam 26 and carrying the element 23. This is also of cup-shape form and is lodged within the element 29 in which it is slidable between two end-of-stroke positions in a first of which, illustrated in the drawing, the element 23 is located against a bottom wall 30 of the element 29, with the cam follower 24 thereby being of minimum length, and in a second of which, not illustrated, the element 23 is displaced against a stop ring 31 rigidly connected to the element 29, thereby obtaining the maximum length of the cam follower 24.

The element 23 can be translated with respect to the element 29, between the said two positions, to a plurality of intermediate positions as well, both in a discrete manner and in a continuous manner, consequently obtaining a plurality of different lengths of the cam follower 24 and therefore different rise and phasing laws of the valve 4. For translating the element 23 the cam follower 24 includes control means operable manually or automatically to move together with the cam follower 24 in the seat 25.

In particular, in a preferred embodiment, the cam follower 24 is hydraulic and the elements 23 and 29 delimit a substantially sealed pressure chamber 32 communicating, through radial holes 33 and 34 formed respectively in grooves 35 of both

the elements 23 and 29, with a lubrication circuit of the engine 1, generally indicated 36. The element 23 is provided with an active surface 37 facing into the chamber 32 and operable to sense the pressure therein to receive a thrust operable to translate the element 23 along the element 29 thereby spacing the end 22 from the axis of the cam 26. To displace the element 23 it is sufficient to put the chamber 32 under pressure, for example by means of a control device 38 connected to the lubrication circuit and operable to intervene automatically in consequence on the variation of one or more operating parameters of the engine 1. Preferably the device 38 is operable to make the element 23 translate along the element 29 during the movement of this latter in such a way as to vary continuously the length of the cam follower 24 in response to the variation of one or more operating parameters of the engine 1, for example speed of rotation, induction pressure, etc., detected by suitable sensors not illustrated. Such sensors send signals to the device 38 which includes, for example, a microprocessor capable of calculating the most suitable rise and phase to give to the valve, in dependence on the signals from the sensors, and consequently to modulate the pressure in the chamber 23 capable of obtaining a length of the cam follower 24 such as to produce a phase and rise of the valve 4 equal to that calculated.

In an improvement of the invention the profile of

the surface 13 of the oscillating cam 14 is chosen in such a way that during a portion of each half oscillation of the cam 14 the surface 13 slides on the end 12 without interfering with it, that is to say the oscillating movement of the rocker 10 follows a smaller arc than that followed by the cam 14 in performing its oscillatory movement. In this way the specific pressure between the rotating cam 26 and the cam follower 24 is reduced in that this latter starts and ends its rectilinear movement in the seat 25 respectively before and after the commencement and termination of the movement of the stem 5 of the valve 4 along its axis. In fact, it happens that for a portion of the reciprocating movement of the cam follower 24 the cam 14 still operates on the rest diameter, not imposing any movement on the rocker 10.

The cam 26 controls the reciprocating movement of the cam follower 24 by means of an opening flank 39 operable to control the translation of the cam follower 24 in a direction such as to open the valve 4, and by means of a closure flank 40 operable to control the translation of the cam follower 24 in the opposite sense, in such a way as to close the valve 4. According to the invention the flanks 39 and 40 have different profiles such as to actuate the valve 4 to open and close with the same law of motion. The compensation of valve play, which cannot be effected on the cam follower 24 without also altering the phase of the valve, is obtained by means of a second hydraulic cam follower 41

rigidly carrying the plunger 18. The cam follower 41 includes a piston 42 which is axially movable and fluid-tightly sealed in a seat 43 and carries the plunger 18; the seat 43 and the piston 42 delimit a pressure chamber 44 permanently connected to the lubrication circuit 36 of the engine 1. From what has been described the advantages of the present invention will be apparent. It allows a valve control mechanism to be obtained which is simple and which has precise and rapid operation and is capable of varying the phase and rise of the valves of the engine in question and to control the valves with the same speeds and accelerations both upon opening and upon closure, or else with any other desired law. The device is moreover simple to automate and in particular is hydraulically operable with means substantially already known and therefore of low cost and high reliability.

From what has been described it will be further clear that variations and modifications can be introduced to the device described without departing from the scope of the present invention. In particular the rod 21 can be omitted and the cam follower 24 can be directly pivoted to the cam 14. Further, the elongation of the cam follower 24 can be obtained with any other means, for example with mechanical and/or electro mechanical or electrical systems.

(Prof. Ing. BONGIOVANNI Guido)

Claims:

1. A mechanical device for the control of a valve (4) of a heat engine (1), of the type operable to allow variation in the rise and phase of the said valve (4), including an oscillating rocker (10) pivoted at an intermediate point and cooperable at a first end (9) with a stem (15) of the said valve (4) movable along its axis against the action of resilient means (7), and at a second end (12), opposite the first (9), with a working surface (13) of an oscillating cam (14) of predetermined profile, and actuating means for the said oscillating cam, characterised by the fact that the said actuating means include a cam follower (24) connected in an articulated manner to the said oscillating cam (14) and movable in a rectilinear manner within a seat (25), and a rotating cam (25) of predetermined profile cooperating with the said cam follower (24) to transmit through this latter an oscillating movement to the said oscillating cam (14).

2. A device according to Claim 1, characterised by the fact that the said cam follower (24) is operable to vary its length between two end positions during the operation of the said heat engine (1), in such a way as to vary the rise and phase of the said valve (4) thereby varying the law of oscillatory movement transmitted to the said oscillating cam (14).

3. A device according to Claim 1 or Claim 2, characterised by the fact that the cam follower (24) includes a first element (29) movable in the said seat (25) and operable to cooperate with the said rotating cam (26), a second element (23) carried by the first and slidable with respect to this latter between two end positions, and control means (38,37,32) for translating the said second element (23) with respect to the first (29) to a plurality of intermediate positions between the said two end positions; the said second element (23) cooperating with the said oscillating cam (14).

4. A device according to Claim 3, characterised by the fact that the said cam follower (24) is an hydraulic cam follower, and the said control means include a pressure chamber (32) delimited by the said first (29) and second (23) element, an active surface (37) carried by the said second element (23) and facing into the said pressure chamber (32), and a plurality of holes (33,34) operable to put the said pressure chamber into communication with a lubrication circuit (36) of the said engine 1.

5. A device according to Claim 3 or Claim 4, characterised by the fact that the said control means include a control device (38) operable to make the said second element (23) translate with respect to the first (29) during the movement of this latter in the said seat (25) in such a way as to vary continuously the length of the said cam follower (24) in response to variations in operating parameters of the said engine (1).

6. A device according to any of the preceding Claims, characterised by the fact that the said cam follower (24) cooperates with the said oscillating cam (14) through at least one push rod (21) pivoted to the said oscillating cam (14) and connected to a movable element (23) of the said cam follower (24).

7. A device according to any of the preceding Claims, characterised by the fact that the said predetermined profile of the said oscillating cam (14) is such that the said working surface (13), during a portion of each half oscillation of the said oscillating cam (14), slides on the said second end (12) of the rocker (10) without interfering with it such that the oscillating movement of the said rocker (10) follows a smaller arc than that followed during the oscillatory movement of the said oscillating cam (14) in such a way that the said cam follower (24) starts and ends its rectilinear movement in the said seat (24) respectively before and after the commencement and termination of the movement of the stem (5) of the valve (4) along its axis.

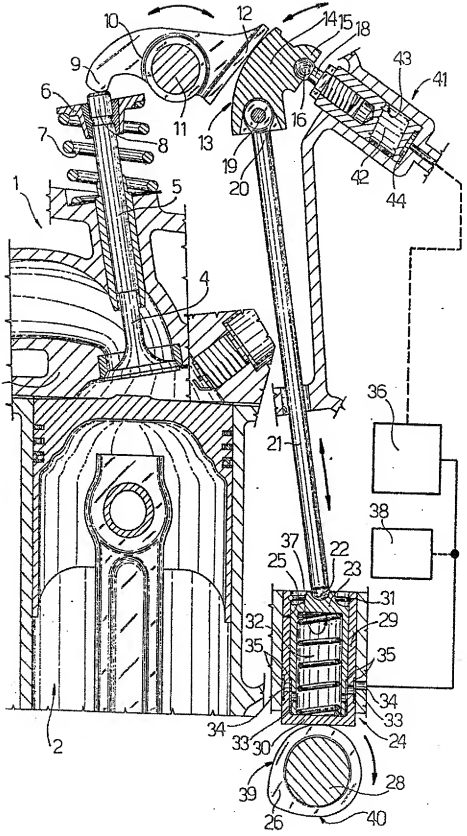
8. A device according to any of the preceding Claims, in which the said rotating cam (26) includes an opening flank (39) operable to control the translation of the said cam follower (24) in one sense such as to cause opening of the said valve (4), and a closure flank (40) operable to control the translation of the said cam follower

(24) in the opposite directional sense, in such a way as to cause the closure of the said valve (4), characterised by the fact that the said opening flank (39) and closure flank (40) have a different profile so as to actuate the said valve (4) to open and close with the same law of movement.

9. A device according to any of the preceding Claims, characterised by the fact that it includes means for compensating valve play, such means including a second hydraulic cam follower (41) carrying a plunger (18) which constitutes the pivoting fulcrum of the said oscillating cam (14).

10. A device according to Claim 9, characterised by the fact that the said second hydraulic cam follower (41) includes a piston (42) axially movable in a fluid-tight seat (43) and carrying the said plunger (18), the said seat (43) and the said piston (42) delimiting a second pressure chamber (44) which is connected to an hydraulic circuit (36) of the said engine (1).

(Prof. Ing. BONGIOVANNI, Guido)


10
12
14
15
18
9
43
41
6
11
13
16
7
8
19
20
42
44
1
5
4
3
36
21
38
37
22
25
23
31
32
29
35
35
34
33
34
33
30
24
2
39
28
26
40

European Patent Office

EUROPEAN SEARCH REPORT

0111768
Application number

EP 83 11 1599

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GB-A-2 053 350 (NISSAN) *Page 1, lines 1-68,110 - page 2, line 6; page 4, lines 13-48; page 3, lines 71-93; figures 1-3*	1-7	F 01 L 31/22 F 01 L 13/00 F 01 L 1/24
A	US-A-2 880 711 (ROAN) *Column 3, lines 1-14; figures 1-3*	7	
A	US-A-2 647 500 (LANG) *Column 1, line 54 - column 2, line 10; figures 1-3*	8	
A	US-A-2 111 734 (RILEG) *Column 1, lines 25-47; figures*	9,10	
A	US-A-2 997 991 (ROAN)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	FR-A-1 171 218 (ETIENNE)		F 01 L
A	FR-A-2 357 731 (CHRYSLER FRANCE)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20-03-1984	KOOIJMAN F.G.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82